Digital Transition for Heritage Management and Dissemination: via Flaminia and Corduba-Emerita

Paolo Clini
Jesús Muñoz Cádiz
Umberto Ferretti
José Luís Domínguez Jiménez
Miriam González Nieto

Abstract

The present article aims to examine and discuss the current European scenario of the virtual archaeology by means of two peculiar case studies. Via Flaminia in Italy and Corduba-Emerita in Spain are two ancient Roman roads which present many similarities in terms of morphology and historical significance. Several regional projects are currently re-designing and redefining the cultural asset of both landscapes. By examining these various and complex frameworks, it has been possible to identify a common starting point in terms of methodologies and survey techniques. Despite this, the results show different approaches and objectives in order to enrich the knowledge of these archaeological areas.

Keywords
Cultural Heritage Enjoyment, Archaeological Landscape, Digital Cultural Heritage, Virtual Archaeology, Virtual Reality



Left, medieval path in the Belmez castle (COR). Right, Tre archi roman bridge, Pontericcioli (PU).

doi.org/10.3280/oa-1016-c425

Introduction

In recent years it has been seen how the digitization of the heritage serves as a help for the exchange of information and for its enjoyment, for both, experts, and the rest of the users. Institutions have difficulty to creating discourses around the rural heritage, focusing on the urban projects. A sustainable development also means the preservation of our heritage and, for this goal, its necessary a real digital transition for a better management of heritage resources, their protection and enjoyment.

The aim of this work is to show the results of two case studies at different stages of development and approaches but complementary: on one hand, the digitization of Via Flaminia (Italy) and the archaeological heritage that revolves around it (fig. 1). This road was inaugurated between 223-2020 b.C. and has as a background a series of pre-Roman roads that linked Rome with *Ariminum*, now Rimini [Clini et al 2015]. On the other hand, the process of archaeological documentation of the Via *Corduba-Mellaria*, in the north of the Cordoba region (Spain). The currently known route must have taken place around the second half of the first century A.D, with the Flavia dynasty, at which time *Mellaria*, would obtain the title of *municipium flavium* (fig.2). Despite its importance in antiquity and the Middle Ages, during the modern era it begins to get confused, disappearing from some studies and maps [Melchor Gil 1995, pp. 115-122; Monterroso Checa y Domínguez Jiménez 2022, p. 194; Domínguez Jiménez in press].

Different approaches. Documenting a roman road. Specific objectives of the DCE project

The *Flaminia NextOne DCE* (Distretto Culturale Evoluto) project brought cohesion to the knowledge of the road and the preserved remains throughout the municipalities, understanding heritage as a stimulus for economic and social development (Clini et al. 2017), The project joins the contemporaneous scenario of the digital transition of Cultural Heritage (fig. 3).

Firstly, the preservation of the Heritage and of the historical memory is one fundamental aspect for every healthy society. Besides that, there are other practical reasons: after the alluvium that occurred in the Marche region in September 2022, many cities, archaeological sites, and infrastructures were seriously damaged. In particular, Ponte Grosso in Cantiano (PU) is currently



Fig. 1. A. Map with the location of the Via Flaminia in the north Marche region. Elaborated from Google Earth Studio.

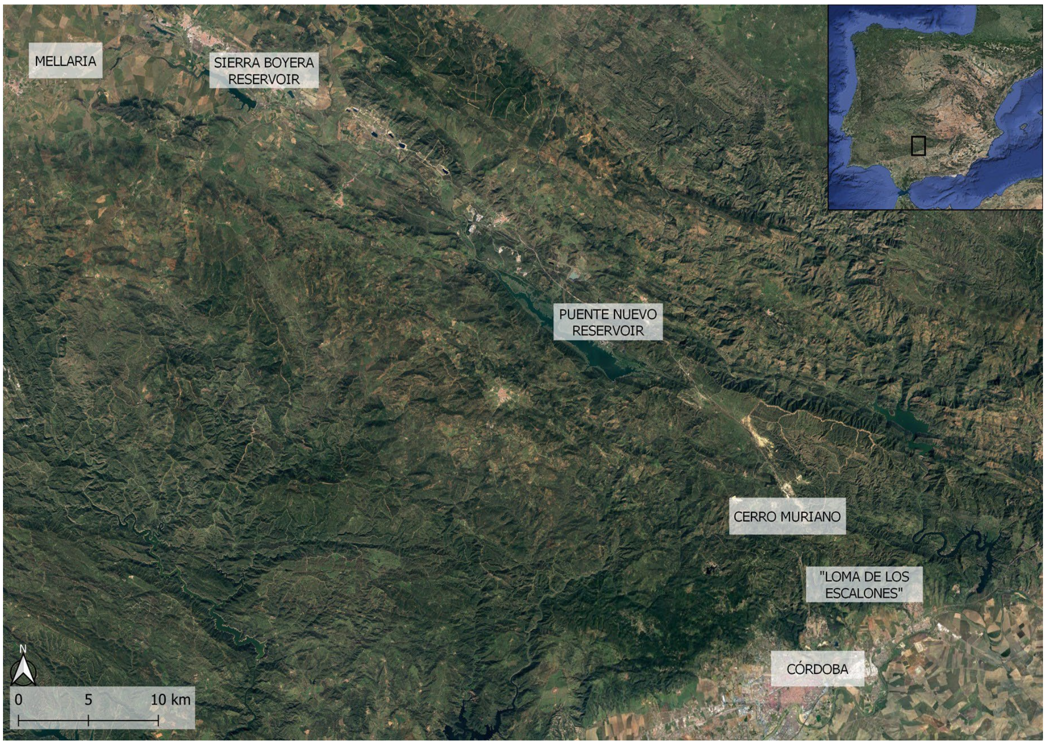


Fig. 2. A Map with the location of the North Cordoba region. Elaborated from PNOAHISTORICO 2004-2019 CC-BY 4.0 scne.es.

condemned due to collapse of the central buttress (fig. 4). Thanks to the development of a digital twin within the *Flaminia NextOne* project, it is possible to virtually access the bridge and many other sites and findings. Furthermore, this collected database is a precious resource for the restoration and reconstruction works.

One of the missions of the project is to spread awareness of these outdoor and indoor sites, which are scattered in the Marche Region. In particular, the part of Via Flaminia involved in this project starts from the valley of the river Metauro, close to the Umbria region boundaries till the city of Fano, in the coast. The role of ICT (Information and Communication Technologies) becomes essential for attracting visitors even to those areas which cannot be reached using the normal and well-established tourist routes. The digital cataloguing includes 3D reconstruction, virtual tour (VT), 360 videos, point cloud, Extended Reality (XR) applications, customized path and is specifically addressed to non-expert users (Clini et al. 2019).

The Via Flaminia Museum

The DCE project is structured in two semantical levels: the first concerns the whole fabric of the Metauro's valley, the second aims to identify and focus on specific points of interest (POI). As regards the first level, one of the main achievements of the project is a multi-channel tourist



Fig. 3. Some graphics of the current documentation of the Via Flaminia through the Flaminia NextOne project.



Fig. 4. Top, the current state of the Ponte Grosso in Cantiano (PU) after the alluvium's damages. Bottom, a scene from the bridge's Virtual Tour from the DCE website.

information system with a website [1] and a mobile app, enriched by some on-site experiences. In addition, the platform has also been designed to collect different types of user statistics on tourist behavior and, more generally, to monitor the service's performance. The mobile app is a cross-platform mobile app available on Android and iOS devices. It provides information such as product news, company lists, contacts etc., and it also allows user participation by sending comments, ideas, suggestions, etc. Furthermore, the system exploits geo-location services to determine the distance between the user and the POI which are available nearby the archaeological sites inviting the user to discover elements and details otherwise difficult to notice and to understand (fig. 5).

In the second level, four strategic areas of reference of Via Flaminia have been identified: the first is the *Museum of the Via Flaminia* built in the Church of San Michele in Fano (PU) and aims to virtually reconnect the Roman archaeological heritage scattered along Via Flaminia, through immersive technologies for communication and monitoring. In particular, two emblematic works are the 3D reconstruction of the city of Fano during the Roman period and the implementation of the virtual model of the *Basilica of Fano* [Clini et al. 2014], based on the Vitruvian treatise. The *basilica* is the container of the virtual museum of the Via Flaminia [2] which allows users from every part of the world to enjoy content from Metauro's valley. The other three projects include the VR/AR exhibition at the Furlo Gorge, the interactive installation in Cagli Museum and the mobile app for augmented reality at the *Forum Sempronii* Archaeological Park, crucial points along the route of the ancient consular road. Such AR application was developed using the Unity open-source development engine. It presents different features and on-site experiences such as the full-scale display of the Forum and the virtual re-contextualization of some mosaic, originally housed in the Roman *Domus* [Crinelli et al. 2016; Mei et al. 2021].

Archaeological documentation in the Via Corduba-Emerita

Although it had been studied (Sillières 1990, pp. 453-466; Melchor Gil 1995, pp. 115-122), the *Corduba-Mellaria* road has not been documented in extent until the realization of an archaeological prospections. This has been due to the difficulty of the territory to

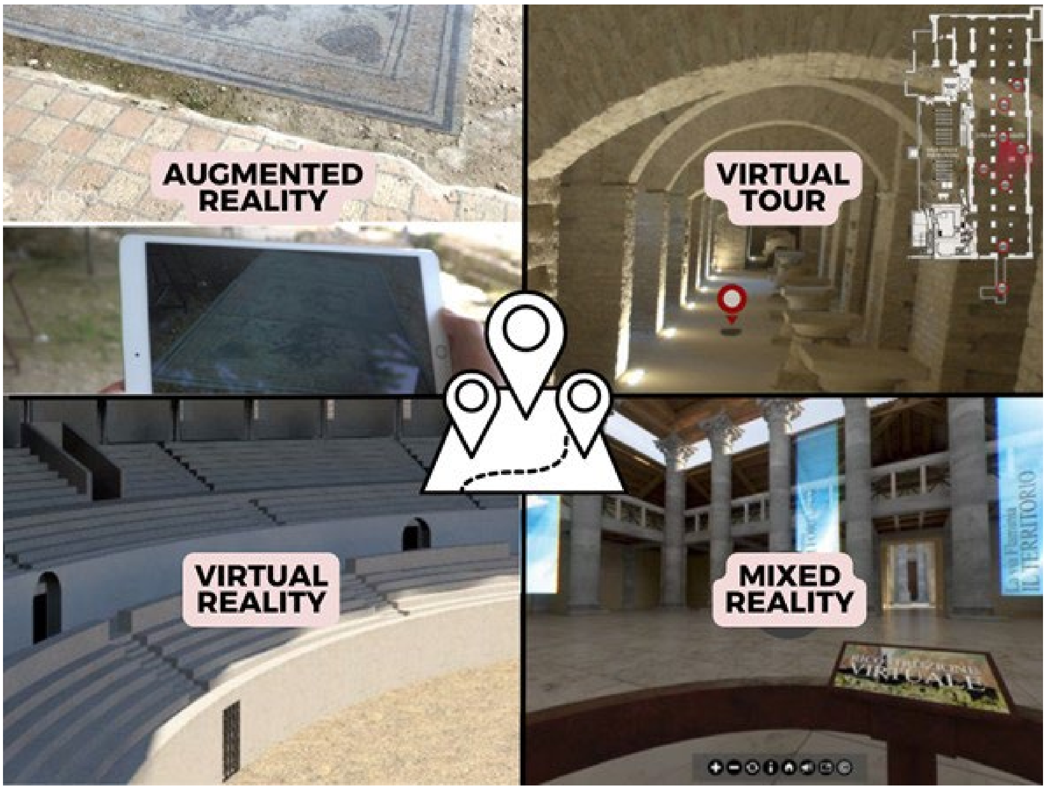


Fig. 5. XR contents generated through the Flaminia NextOne DCE Project.

study, for example, the exit of Cordoba, affected by newly urbanized areas, new quarries, and strong slopes, knowing only some small sections worked on the rock, such as the *Loma de los Escalones* (fig. 6).
The University of Córdoba has used aerial remote sensing techniques, from orthophotography to LiDAR in UAV. The territory chosen for the application of these methodologies has not been casual, selecting the reservoir of *Puente Nuevo*, at a very low level due to droughts, and where some archaeological remains had emerged. The result has been the documentation of the Vía Corduba-Emerita along at least 11 kilometres and other structures in its path [Gasparini, Moreno Escribano y Monterroso Checa 2019] (fig. 7).
This first step of prospection was followed by the digitization of some sections as around the Santuario de la Virgen de Linares and *Loma de Los Escalones* [Domínguez Jiménez y González Nieto 2019; Monterroso Checa y Gasparini 2016]. In addition to the aerial remote sensing, NDVI spectral photography was used to capture the road in the Roman city of *Mellaria*, the midpoint between *Colonia Patricia* and E*merita Augusta* [Monterroso Checa y Domínguez Jiménez 2022]. Considering the importance of the discovery, surveys were carried out with magnetic sensors on the ground of the old *municipium*, obtaining the road, which served as the road axis of the city [Domínguez Jiménez et al. 2022] (fig. 8). The necessary step after documentation was excavation, so in 2022 a small excavation was carried out in what had been identified as the main axis of *Mellaria*, confirming the previous surveys and even documenting urban structures.
The documentation has been fundamental for the knowledge of the road, which is now in its digitisation phase. *GuadiatVR* project collects some of the first results (https://www.uco.es/guadiatvr/), through a 3D immersive experience that recreates the landscape of the Alto Guadiato through time and in which you can observe the Corduba-Emerita road near to the hill of the castle of Belmez. Another result is the possibility of a digital hot air balloon flight exploring the same territory (fig. 9). The results of this project were shown in the International Tourism Trade Fair (FITUR) of Madrid and having presence in press and radio [Monterroso-Checa et al. 2020; Domínguez Jiménez et al. 2021].

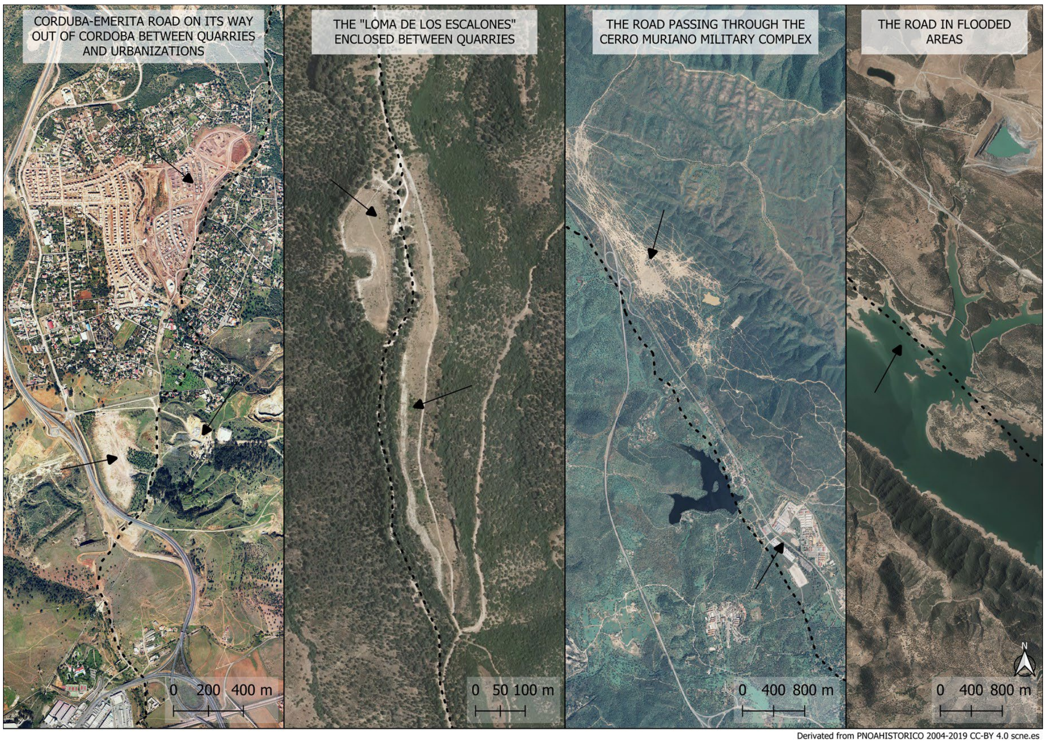


Fig. 6. Examples of some of the difficulties for the study of the roman road.

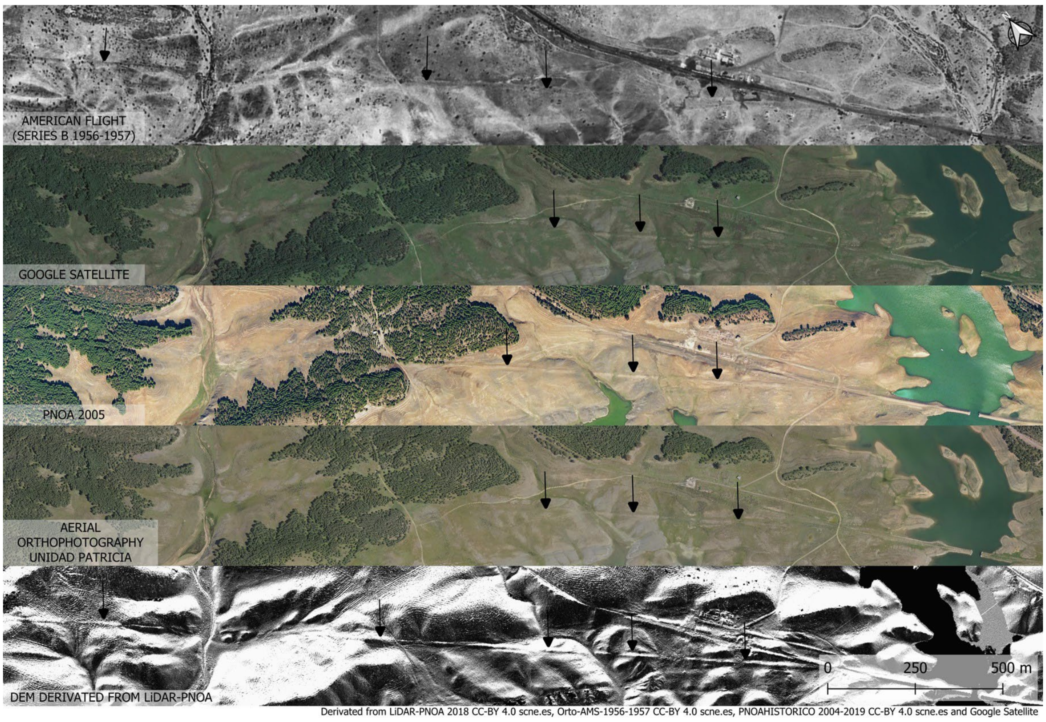


Fig. 7. The Via Corduba-Emerita detected in different periods and with different resources.

Application of the methodology in the Vía Corduba-Sisapo

The *Corduba-Sisapo* road is another of the most important of the *Conventus Cordubensis* due to the products that were transported from the mines of the Alcudia Valley [Zarzalejos 2011]. Due to the lack of awareness, recently efforts have been initiated for its documentation through the project *Producción y circulación de bienes en el reborde meridional de la*



Fig. 8. Geomagnetic survey, detecting the road as it enters *Mellaria*.

meseta (sur de la provincia de Ciudad Real) entre la prehistoria reciente y el fin de la antigüedad (UNED). For its recognition, it has sought to follow a similar methodology, but the application of GIS is complex because there is no record of any preserved section. In this sense, the implementation of least cost path calculations has been key, which focus on analysing the least cost cells from raster layers, obtaining a vector layer with optimal tracing. These results have allowed us to limit the main study area and facilitate aerial prospection using LiDAR. The site of *Majadaiglesia* is being studied since everything seems to indicate that it could refer to the Roman city of *Solia*, the only known city between *Corduba* and *Sisapo* (González Nieto y Domínguez Jiménez in press), just as *Mellaria* was the only city known in the Via Corduba-Emerita in the *Conventus Cordubensis*. These works consist of the application of techniques of aerial orthophotography, photogrammetry and LiDAR in UAV, with the help of the Patricia Unit of the University of Córdoba. The results will be enjoyed both in the academic field and for the rest of society through its digitization and virtualization, taking as an example the cases studied mentioned above (fig. 10).



Fig. 9. VR experiences of the Via Corduba-Emerita and the Alto Guadiato territory (Córdoba, Spain).

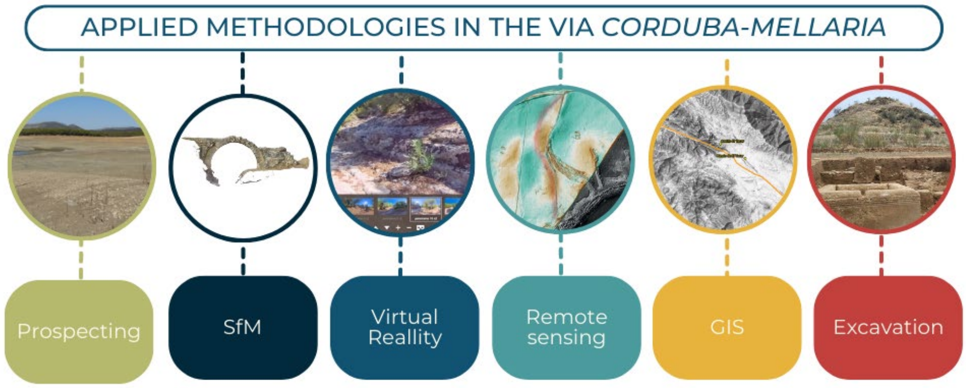


Fig. 10. Workflow in the *Ager Mellariensis*/ AEI FEDER HAR 77136 projects.

Conclusions

The comparison between these two case studies allows a more in-depth analysis of the adopted frameworks, highlighting their strengths and weaknesses. Both projects enabled, in recent years, the implementation of digital twins thanks to several acquisition campaigns using sophisticated photogrammetry techniques.
Starting from this similar background, it is possible to identify different paths and strategic objectives. In the Spanish case, the virtual cataloguing deals with the sites management by means of Geographic Information System (GIS) and therefore is addressed to expert users. In the Italian case, the same digital transformation is oriented to site's enjoyment, hence, in contrast with the previous one, is addressed to non-expert users (fig. 11).
The significant size of Corduba-Emerita assumes a low level of accessibility to the points of interest. Therefore, given the robust results obtained within the scientific aspects, it is essential to reprocess and synthesize this data in order to enable the site's experience by a wider audience. In the Via Flaminia case, it is very important to take due measures for developing a geographical information system. The digitization of Cultural Heritage in rural areas should be the container of future research that institutions should use effi-

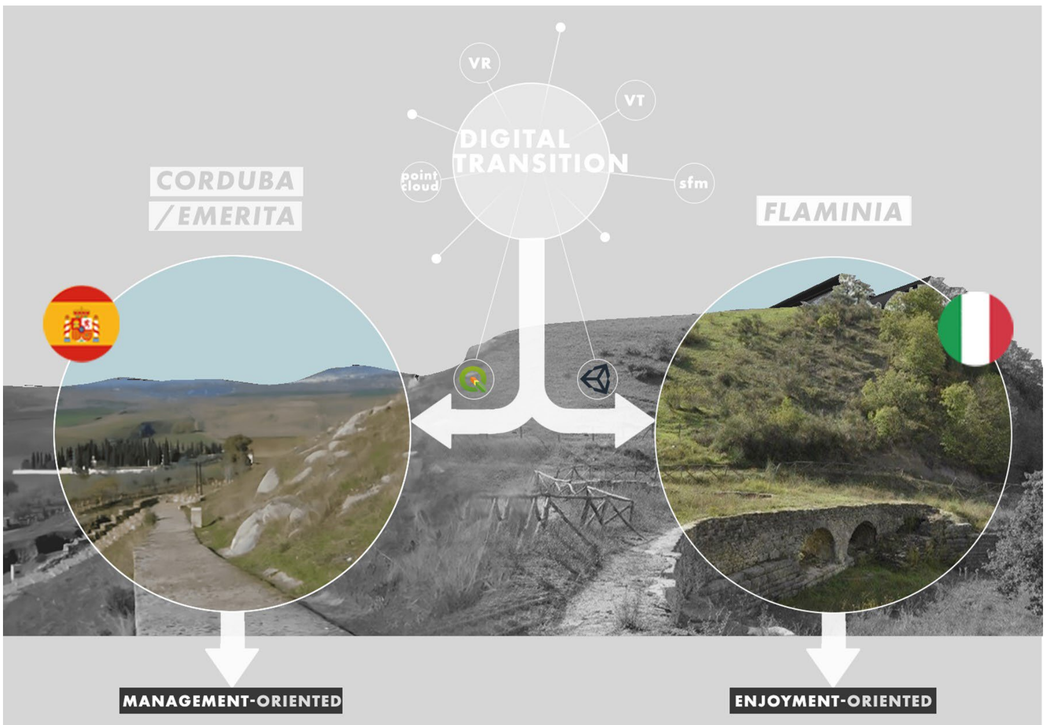


Fig. 11. The chart shows that both projects' digital transition starts from a shared sound base (similar survey techniques, usage of technological tools). Since in Corduba-Emerita a GIS-based framework (Qgis software) is implemented, it can be considered as more management-oriented. In the Via Flaminia Project, the digital data was exploited for developing XR applications by means of gaming development platforms (Unity), hence the framework can be considered more enjoyment oriented.

ciently for the economic and social development of the region. The complementarity of these case studies suggests the adoption of a common framework where ideas, skills and experiences can be shared. The goal is the implementation of multi-purpose and even more sophisticated solutions for preservation, enhancement and dissemination of the archaeological heritage.

Notes

[1] <https://www.flaminianextone.eu/it/1/alias/11/>.

[2] <https://distori.org/>.

References

Clini P., Frontoni E., Quattrini R., Pierdicca R., Puggioni M. (2019). Archaeological landscape and heritage. Innovative knowledge-based dissemination and development strategies in the "Distretto Culturale Evoluto Flaminia NextOne". In IL *CAPITALE CULTURALE. Studies on the Value of Cultural Heritage* No. 19, pp. 211-235.

Clini P., Lenci S., Amadei D., Bertuccioli L., Camerini E., Del Gaiso C. (2014). La Basilica di Vitruvio di Fano: un approccio di archeologia sperimentale per la validazione di un modello 3D. In *SCIRES-IT-SCIentific RESearch and Information Technology,* Vol. 4, No. 1, pp. 69-84.

Clini P., Nespeca R., Crinelli G. (2017). Il Distretto Culturale Evoluto Flaminia Nextone. Innovazione digitale nel nuovo museo virtuale della Via Flaminia a Fano. In *Territori e frontiere della rappresentazione. Proceeding of the 39th International Conference of representation Disciplines Teachers*. Naples 14-16 September 2017, pp. 821-828. Rome: Gangemi.

Clini P., Quattrini R., Frontoni E., Nespeca R. (2015). A New Cloud Library for Integrated Surveys: The Ancient Via Flaminia and the Nextone Project (Chapter 20)". In S. Brusaporci (Ed.). *Handbook of research on emerging digital tools for architectural surveying, modeling and representation*, pp. 579-606.

Crinelli G., Clini P., Quattrini R., Leoni F. (2016), Integrated Strategies of Promotion and Communication for Diffuse Cultural Heritage: A Pilot Project Inside Flaminia Nextone DCE. In *Landscape & Archaeology - I quaderni di Careggi. Conference Proceedings of L&A En Route*. Fano, Fossombrone, Cagli, 23-25 June 2016, pp. 305-313. Fossombrone: UNISCAPE.

Dell'Amico A. (2022). Memoria e modello digitale. La costruzione di un sistema informativo per la salvaguardia del patrimonio architettonico diffuso dell'Upper Kama. In *Restauro Archeologico* 30(1), pp. 32-53.

Domínguez Jiménez J.L. (in press). El ager mellariensis: estudio del espacio central del Conventus Cordubensis (Alto Guadiato, Córdoba). In *Pueblos y Culturas de la Prehistoria a la Actualidad*. Dykinson S.L.

Domínguez Jiménez J.L., Castilla Agredano B., González-Nieto M., Moreno-Alcaide M., Monterroso-Checa A. (2021). Preparing rural heritage for another kind of Covid pandemic: heritage digitalization strategies in the Alto Guadiato Valley and Subbetica of Cordoba, Spain. In *SCIRES-IT-SCIentific RESearch and Information Technology*, Vol. 11, No. 1, pp. 195-208.

Domínguez-Jiménez J.L., González-Nieto M. (2019). Modelos fotogramétricos para el estudio de la rehabilitación medieval de la vía Corduba-Emerita en el entorno del Santuario Linares (Córdoba). In *Antiqvitas*, No. 31, pp. 21-30.

Domínguez Jiménez J.L., Gutiérrez Deza M.I., Monterroso Checa A., Gasparini M., Moreno Escribano J.C. y González Nieto M. (2022). Documentación gráfica mediante Sensores Teledetectivos de naturaleza RGB y Magnética para la definición cartográfica de la ciudad romana de Mellaria (Fuente Obejuna, Córdoba). In *Anuario Arqueológico de Andalucía*.

Gasparini M., Moreno-Escribano J.C., Monterroso-Checa A. (2019). Identifying the Roman road from Corduba to Emerita in the Puente Nuevo reservoir (Espiel-Córdoba/Spain). In *Journal of Archaeological Science: Reports,* Vol. 24, pp. 363-372.

González Nieto M., Domínguez Jiménez J.L (in press). *Los pasos del sur hispano en Sierra Morena: los valles de Alcudia y del Guadiato como estructuradores del espacio socio-económico*. Iberica: Selecta.

Filippini G., Invernizzi L. (2021). Distretto Culturale Evoluto Flaminia NextOne: innovazione tecnologica per l'archeologia e la valorizzazione digitale della Via Flaminia e di Forum Sempronii. In R. Perna, R. Carminati, M. Giuliodori, J. Piccinini. *Roma e il mondo adriatico. Dalla ricerca archeologica alla pianificazione del territorio*, Vol. 1, pp. 187-202. Quasar.

Melchor Gil E. (1995). *Vías romanas de la provincia de Córdoba*. Publicaciones Obra Social y Cultural Cajasur.

Monterroso Checa A., Domínguez Jiménez J.L. (2022). La gran vía Corduba-Emerita, el territorio y la explotación del corazón aurífero del Conventus Cordubensis. In Actualidad de la investigación arqueológica en España. Ciclo IV. Conferencias impartidas en el *MAN*, pp.183-200. Ministerio de Cultura y Deporte.

Monterroso Checa A., Gasparini M. (2016). Aerial Archaeology and photogrammetric surveys along the roman way from Corduba to Emerita. Digitalizing the ager cordubensis and the ager mellariensis. In *SCIentific RESearch and Information Technology*, Vol. 6 No. 2, pp. 175-188.

Monterroso Checa A., Redondo Vila A., Gasparini M., Hornero A., Iraci B., Martín Talaverano, Zarco Tejada P.J. (2020). A Heritage Science Workflow to Preserve and Narrate a Rural Archeological Landscape Using Virtual Reality: The Cerro del Castillo of Belmez and Its Surrounding Environment (Cordoba, Spain). In *Applied Sciences*, Vol. 10, No. 23.

Pierdicca R., Puggioni M. (2019). Archaeological landscape and heritage. Innovative knowledge-based dissemination and development strategies in the "Distretto Culturale Evoluto Flaminia NextOne". In *Il Capitale Culturale*. *Studies on the Value of Cultural Heritage* No. 19, pp. 211-235.

Sillières P. (1990). *Les voies de communication de l'Hispanie meridionale*. Paris: Publications du Centre Pierre Paris.

Zarzalejos Prieto M. (2011). La investigación arqueológica de los paisajes mineros antiguos en la vertiente norte de Sierra Morena (provincia de Ciudad Real). In *De re metallica (Madrid): revista de la Sociedad Española para la Defensa del Patrimonio Geológico y Minero,* No. 17, pp. 55-66.

Authors
Paolo Clini, Università Politecnica delle Marche, p.clini@staff.univpm.it
Jesús Muñoz Cádiz, Università Politecnica delle Marche, S1106582@pm.univpm.it
Umberto Ferretti, Sapienza Università di Roma, umberto.ferretti@uniroma1.it
José Luís Domínguez Jiménez, Universidad de Córdoba, joseluisdj@uco.es
Miriam González Nieto, UNED- Universidad Nacional de Educación a Distancia, miriamgonzalez@geo.uned.es

To cite this chapter: Clini Paolo, Muñoz Cádiz Jesús, Ferretti Umberto, Domínguez Jiménez José Luís, González Nieto Miriam (2023). Digital Transition for Heritage Management and Dissemination: via Flaminia and Corduba-Emerita. In Cannella M., Garozzo A., Morena S. (Eds.). *Transizioni. Atti del 44° Convegno Internazionale dei Docenti delle Discipline della Rappresentazione/Transitions. Proceedings of the 44th International Conference of Representation Disciplines Teachers*. Milano: FrancoAngeli, pp. 2613-2622.

 Isbn 9788835155119